Picomolar detection of 4-nitrophenol using a polyaniline/platinum - coated fiber optic surface plasmon resonance sensor

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Fiber Optic – Surface Plasmon Resonance (FO-SPR) technology has been recognized as a remarkable optical sensing tool in various fields of life science, agro-food sector and medical diagnostics, as it can provide efficient characterization and real-time quantification of various biological entities [1]. Potential applications can span from studying interactions between proteins, lipids, nucleic acids, to even low molecular weight molecules such as drugs [2-3].
Herein, we present an innovative polyaniline (PANI)/platinum (Pt)-coated fiber optic – surface plasmon resonance (FO-SPR) sensor (see Figure 1) used for highly-sensitive 4-nitrophenol (4-NP) pollutant detection. The Pt thin film was coated over an unclad core of an optical fiber (FO) using a DC magnetron sputtering technique, while the 4-NP responsive PANI layer was synthetized using a cost-effective electroless polymerization method. The presence of the electrolessly-grown PANI on the Pt-coated FO was observed by field-emission scanning electron microscopy (FE-SEM) and subsequently evidenced by energy dispersive X-ray analysis (EDX). These FO-SPR sensors with a demonstrated sensitivity of 1515 nm/RIU were then employed for 4-NP sensing, exhibiting a promising limit of detection (LOD) in the low picomolar range (0.17 pM). The proposed sensor's configuration has many other advantages, such as low-cost production, small size, immunity to electromagnetic interferences, remote sensing capability, and moreover, can be operated as a "stand-alone device", making it thus well-suited for applications such as "on-site" screening of extremely low-level trace pollutants.
This work was supported by the "Executive Unit for Financing Higher Education, Research, Development and Innovation" - UEFISCDI (Romania) through the grants PN-III-P1-1.1-PD-2019-0466 and PN-III-P1-1.1-TE-2019-0868, the National Authority for Research and Innovation in the frame of Nucleus Programme - LAPLAS VI (contract 16N/08.02.2019) and by the University of Bucharest, Faculty of Physics through a doctoral scholarship.

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FIGURES

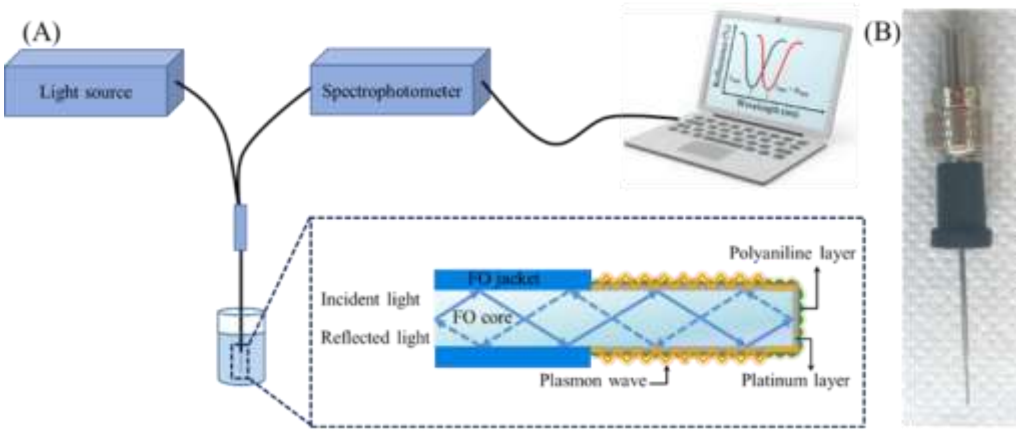

Figure 1: Schematic of the FO-SPR setup (A) and a picture of the fabricated Pt-coated FO-SPR sensor (B).